

This Appendix was prepared from Issue 31 of Drawing ST-52005-03.

METHOD OF OPERATION

Line Circuit - District Selector Circuit - Line Finder Circuit - Arranged For
Two Party Message Rate Lines - 400 Point Lockout Type Line Finder - Panel
System.

Change paragraph 20 and 21 to read:-

20. LINE FINDER TIME ALARM WITHOUT TRIP CIRCUIT RELEASE ("P" WIRING)

20.1 Alarm Signal

If a line finder does not find the subscriber's line within 35 seconds after the receiver at the calling station is removed from the switchhook, an alarm is given in the following manner: The (BA) relay operated connects battery to winding of the (frame) relay (B), brush and terminal 1 of the START arc of the time alarm selector, break contact of the frame relay (A), to the interrupter contact. When the interrupter contact closes, the (B) relay operates. The (A) relay does not operate, however, on account of its winding being short circuited by ground on the interrupter. When the interrupter contact opens, the short circuit is removed from the winding of the (A) relay, which now operates in series with the winding and make contact of the (B) relay, to ground on the armature of the (B) relay, thus holding both relays operated. The next operation of the interrupter operates the (TA) magnet, over a circuit from ground on the make contact of the interrupter, make contact of the (A) relay, terminal 1 and brush of the STEP arc of the selector, to battery through the winding of the (TA) magnet. When the interrupter contact opens, the (TA) magnet releases and steps its brushes one step on its back stroke. The selector brushes advance one step for each make and break of the interrupter contact, which is of an interval of 7 seconds, until the fifth terminal of the selector is reached when the circuit through the interrupter is opened. When the fifth terminal of the selector is reached, the (BA) lamp in the trip circuit lights from battery on the armature of the (A) (frame) relay, terminal 5 and brush of the LAMP arc of the selector, through the make contact of the (BA) relay, (BA) lamp to ground through the winding of the (B) (aisle) relay in the time alarm circuit, which operates. The (B) relay operated, operates an (A) (aisle) relay (not shown). The (A) relay (not shown) operated, lights the aisle pilot and main or monitoring board lamps through their respective auxiliary alarm

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for the purpose of increasing the efficiency of the system, it is recommended that the alarm circuit be modified as follows:

circuits. When the source of trouble is removed and the (BA) relay in the trip circuit has released, the circuits over the make contacts of the (BA) relay are opened, in turn releasing both the frame and aisle (A) and (B) relays, extinguishing the aisle and main or monitoring board lamps and silencing the alarm. The release of the (B) (frame) relay also closes a circuit from ground on its armature, through terminal 5 and the bridging brush of the RETURN arc of the selector to battery through the break contact and winding of the (TA) magnet, which operates and steps the selector brushes to terminal 6, in which position it awaits the next closure of contacts of the (BA) relay.

20.2 Restoring To Normal

Should the circuit over the make contact of the (BA) relay be opened before the fifth terminal is reached by the selector, the (A) and (B) frame relays release. The (B) relay released, causes the selector to advance to the next normal position, awaiting closure of make contact of the (BA) relay, as previously described. The operation of the (TA) key steps the selector brushes to the next normal position by way of the STEP bridging brush and 5, 10, 15 or 20 terminal, as the case may be. If the selector has been at normal position 6, 11 or 16, when the (BA) relay operated, the operation would have been the same as described for position 1.

21. LINE FINDER TIME ALARM WITH TRIP CIRCUIT RELEASE ("U" WIRING)

21.1 The circuit description for this feature will be found in BT-226379 which is the method of operation for ES-226379.

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S.C.E.
March 30, 1933.

Western Electric Co., Incorporated,
Equipment Engineering Branch, Hawthorne

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Appendix 1
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METHOD OF OPERATION

Line Circuit - District Selector Circuit and Line Finder Circuit - Arranged
for Two-Party Message Rate Lines - 400 Point Lockout Type Line Finder -
Panel System.

This appendix is issued to add paragraphs 55 and 56 which read as
follows:

55. SUB-GROUP "A" LINE FINDERS ONLY EQUIPPED

When only sub-group "A" line finders are equipped "C" wiring is
omitted and "D" wiring furnished, and the operation of relay (SA)
when a call comes in with all "A" line finders busy and relay (CA)
operated, operates the message register. Also relay (STB) is pre-
vented from operating under this condition by the omission of "G"
wiring.

56. SUB-GROUP "B" LINE FINDERS ONLY EQUIPPED

When only sub-group "B" line finders are equipped "LL" wiring
is omitted and "NN" wiring furnished, and the operation of relay
(SB) when a call comes in with all "B" line finders busy and relay
(CB) operated, operates the message register. Also relay (STA) is
prevented from operating under this condition by the omission of
"LL" wiring.

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METHOD OF OPERATION

Line Circuit - District Selector - Circuit And Line Finder - Circuit - Arranged For Two-Party Message Rate Lines - 400 Point Lockout Type Line Finder - Panel Machine Switching System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

- 1.1 To establish connections between subscriber's stations and the apparatus in the mechanical office.
- 1.2 To find the calling subscriber's line and connect it with the various switching apparatus necessary to complete a call.
- 1.3 To provide a timing feature on signals to the attendant, when an originating call is not connected to a line finder in a specified time period.

2. WORKING LIMITS

- 2.1 B1 relay (DC) maximum subscriber's loops 750 and 900 ohms with a minimum leak of 10,000 ohms.
- 2.2 206-L (CS) relay maximum external circuit loop 3025, 3910 and 5010 ohms for 24 volt battery or 7350, 9200 and 11,470 ohms for 48 volt battery.

OPERATION

3. PRINCIPAL FUNCTIONS

- 3.01 To start a line finder hunting for the calling line.
- 3.02 To trip the proper line finder brushes.
- 3.03 To operate the proper message register on a charge call.
- 3.04 To operate the line finder time alarm.
- 3.05 To disconnect the battery and ground from a subscriber's line on an incoming call.

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3.06 To route the call.

3.07 To start a selector hunting for the calling time.

3.08 To release the trip relay in the associated trip circuit, thus permitting another call to start in any other group.

3.09 To prevent a second call being served in any trip circuit until all calls waiting in other trip circuits have been served.

3.1 Each regular start circuit is equipped with an emergency plug and jack for immediately replacing the regular circuit with an emergency circuit at any time.

3.2 To find the proper line and start the sender hunting for an idle sender selector.

3.3 To establish talking connection.

3.4 To supply talking battery to the calling station.

3.5 To select an idle sender.

3.6 To connect battery for the operation of the message register in the line circuit on a charged call.

3.7 To connect a busy tone to the calling station, if required.

4. CONNECTING CIRCUITS

4.1 Any subscriber's line.

4.2 Any standard office or incoming selector circuit.

4.3 Any standard sender circuit.

4.4 Any standard final circuit.

DESCRIPTION OF OPERATION

5. ORIGINATING A CALL

The operation for a call originating in the first 20 lines of a group of 40 lines is as follows: When the receiver at the calling station is removed from the switchhook the (L) relay in the line circuit operates. The (L) relay operated connects battery to the H terminal of

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the line and operates the (BA) relay. The (BA) relay operated operates the (TR) relay from ground through the contacts of the (O), (BA) and (K) relays, secondary winding of the (TR) relay to battery over the TR lead, contacts of (STB) relay in start circuit and closes a circuit operating the (AL) relay in the start circuit. The (TR) relay operated operates the trip magnets, opens the locking series circuit through the (TR) relays in the other trip circuits, serving other groups of 40 lines of the same 400-line unit and locks through its primary winding in series with the (STA) relay in the start circuit.

6. STARTING A LINE FINDER

When the (STA) relay in the start circuit operates, (a) It starts a line finder hunting for the calling line. Each trip magnet operates its trip rod, tripping the corresponding group brush of the line finder as it passes the tripping zone. (b) Short circuits the 500 ohm winding of the (CA) relay preventing it from operating while the (STA) relay remains operated. (c) Closes a circuit from ground operating the (K) relay under control of the (TR) relay. (d) Closes a circuit operating the (LF) relay in the line finder circuit, from ground through contacts of (GA) and (C) relays, (A-1) bridging brush and terminal of the (A) selector over lead ST, contact of the (MB) relay, contact of the test jack, to battery through 1000 ohm winding of (LF) relay. The (K) relay operated, locks to ground on the armature of the (BA) relay through the back contact of the (O) relay, opens the circuit through the secondary winding of the (TR) relay, thus preventing another line finder from being started by this call and operates the (LO) relay which closes the circuit through the 1500 ohm winding of the (O) relay and releases the (AL) relay in the start circuit providing the (AL) relay is not held operated over the (AL) lead of another trip circuit by a call waiting to be served. The (O) relay does not operate at this time on account of insufficient current through the winding.

7. The (LF) relay operated (a) Locks on its contact and windings in series to ground on the make contact of the (H) relay. (b) Closes a circuit over lead Y operating the (GA) relay in the starting circuit. (c) Operates the UP magnet from ground on the "N" commutator, brush and segment causing the line finder selector to travel upward and hunt for terminals on the calling line. (d) Closes a circuit from ground on the "N" commutator brush and segment through the break contact of the (E) relay, to battery through the inner winding of the (CI) relay, operating the (CI) relay.

8. The (GA) relay operated (a) Removes ground from lead ST. (b) Locks to ground on the armature of the (STA) relay. (c) Closes a circuit operating the STP-A magnet.

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9. FINDING A SENDER

As the line finder selector starts upward, hunting for the calling line, a circuit is closed through the M commutator, slightly after the brushes of the selector move off-normal. Ground on the M commutator brush and segment, operates the line finder (E) relay. The (E) relay operated, (a) operates the (MB) relay, (b) closes a circuit, operating the (D) relay, (c) opens the operating circuit of the (CI) relay, thus permitting the relay to release if the test brush of the sender selector is making contact with the test terminal of an idle sender. If the test brush of the sender selector is making contact with the test terminal of the busy sender, the (CI) relay locks through its outer winding, lower contacts of cam S, to ground on the test brush of the sender selector. With the (CI) relay held operated, the operation of the line finder, (E) relay also closes a circuit operating the (F). relay in the line finder circuit and the district selector (SS) magnet. This circuit is traced from battery through the 1,000 ohm winding of the (F) relay and through the windings and break contact of the (SS) magnet, make contacts of the (CI) and (E) relays to ground on cam H, thereby stepping the sender selector brushes one step on its back stroke. If the next sender circuit is idle the (CI) relay releases, in turn stopping the selector but if the next terminal is busy, the (CI) relay remains operated and the sender selector continues to step until an idle sender is found. When the (CI) relay releases, the test terminal of the selected sender is immediately made busy to all hunting sender selectors by ground connected to the test brush from cam H, through the make contact of the (E) relay and the break contact of the (CI) relay. This busy ground is connected until the switch advances from position 1-1/4. The operation of the (F) relay opens the tip and ring leads between the line finder commutator and the district circuit and prevents the district (L) relay from operating and advancing the district switch from normal, should the line finder selector connect to the terminals of the calling line before the sender selector finds an idle sender.

MAKING DISTRICT BUSY

10. THE (MB) RELAY OPERATED

(a) Locks to ground on lead X so that the (MB) relay will not release should the selector return to normal while another call is going through, (b) closes a circuit to battery through the 800 ohm winding of the (F) relay which operates, if it was not previously operated, (c) connects ground on its armature to the series circuit through the (MB) relays of the other selectors in the same group, thus permitting the

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operation, over lead "CH" of the (CA) or (CB) relays in the starting circuit, when all line finder selectors in the group are off-normal, (d) opens the circuit over lead Y, to prevent the (GA) relay from reoperating, (e) transfers the ST lead to the next line finder, which, if busy, transfers the call over the ST lead in the same manner until an idle line finder is found.

11. RELEASING THE TRIP AND START CIRCUITS

As the line finder selector continues upward, at the end of the tripping zone, the "K" brush makes contact with the "K" commutator and connects ground to lead "K" which causes the (TR) relay in the trip circuit to release but holds the (STA) relay operated. The release of the (TR) relay closes the series locking circuit through the winding of the (TR) relays in the other groups and releases the two associated trip magnets. When the "K" commutator brush moves off the commutator segment, ground is disconnected from the "K" lead causing the (STA) relay to release. The release of the (STA) relay (a) opens the locking circuit through the (GA) relay which releases, (b) opens the circuit over lead "X", thereby opening the locking path of the line finder make busy relay, (c) opens the circuit through the (STP-A) magnet which releases and steps the brushes of the A group distributor selector to the next terminals, (d) removes the short circuit from the 500 ohm winding of the (CA) relay, but the (CA) relay will not operate unless all selectors in the group are busy.

12. LINE FINDER FINDS LINE

When the selector brushes make contact with the terminals associated with the calling line, battery on the "H" terminal operates the (O) relay in the trip circuit and the (H) relay in the line finder circuit. With the (H) relay operated, a 50 ohm non-inductive shunt is connected around its winding to ground on its armature for the purpose of increasing the amount of current through the 500 ohm winding of the (O) relay in the trip circuit thus speeding its operation. This is necessary on account of the very short time period during which the "H" brush makes contact with the "H" terminal before the circuit over the "H" lead is opened by the overthrow of the selector. The (O) relay operated opens the locking circuit of the (K) relay but the (K) relay is slow in releasing and holds the (LO) relay operated thereby holding the (O) relay operated through its 1500 ohm winding in order to permit the (BA) relay to release before the (O) relay. Otherwise another line finder might be started by this call. The (H) relay operated, opens the circuit which holds the (LF) relay operated, but the (LF) relay does not release immediately on account of a circuit being closed from ground

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on the "C" commutator brush and segment to battery through both windings of the (LF) relay in series. The (LF) relay is thus held operated until the brushes are centered on the terminals of the calling line. When the circuit through the "C" commutator segment is opened, the (LF) relay releases. The release of the (LF) relay (a) opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the calling line, (b) opens the circuit through the 800 ohm winding of the (F) relay so that when the circuit through its 1000 ohm winding is opened by the release of the (CI) relay when the district sender selector seizes an idle sender, the (F) relay will release, (c) closes a circuit operating the (SL) relay. This circuit is traced from ground on the "M" commutator, break contact of the (LF) relay, make contact of the (E) relay, winding of the (SL) relay, cam T, make contact of the (D) relay, to battery on the break contact of the (DS) relay.

The operation for a call originating in the last 20 lines of a group of 40 lines will be similar to that already described for the first 20 lines except that the (STB), (CB) and (GB) relays are involved instead of the (STA), (CA) and (GA) relays.

13. THE ADJUSTMENT OF THE "C" COMMUTATOR BRUSH

The adjustment of the "C" commutator brush, with relation to the tripped "H" multiple brush is such, that it does not break contact with the "C" commutator segment, until slightly after the holding circuit through both windings of the (LF) relay is opened by the operation of the (H) relay when the H brush makes contact with the H terminals to which battery is connected. The UP magnet, therefore remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the line terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through both windings of the (LF) relay is opened at the "C" commutator, releasing the relay. The (LF) relay released, releases the UP magnet. The selector then drops into place, thus centering the brushes on the line terminals.

14. LOCKOUT FEATURE

The operation of the lockout feature is as follows: The operation of the (BA) or (BAL) relay when a call is started operates the (AL) relay in the start circuit through the normally closed contacts of the (LO) relay. The (AL) relay operated, holds the (LO) relays of any other trip circuits locked up which may be operated. The operation of the (K) or (K-1) relay after the (STA) or (STB) relay operates causes the operation of the (LO) relay. The operation of the (LO) relay will release

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the (AL) relay in the start circuit provided it is not held operated over the (AL) lead of another trip circuit by a call waiting to be served. If no calls are waiting in other trip circuits the release of the (K) or (K-1) relay after the line has been found will release the (LO) relay. However, if calls are waiting to be served in other trip circuits the (AL) relay in the start circuit will remain operated, holding the (LO) relay in this trip circuit operated. The (LO) relay operated holds ground on the 1500 ohm winding of the (O) relay preventing the (O) relay from releasing until calls waiting in other trip circuits have progressed far enough to operate their corresponding (LO) relays, thereby releasing the (AL) relay. The (O) relay being held operated prevents a second call from starting in this trip circuit.

15. OVERFLOW

If a line finder fails to stop on a subscriber's line on account of the H lead being open, due to the subscriber flashing his switchhook or for other reasons, the line finder will travel to the top of the bank where the brush will make contact with the H comb operating the (O) relay in the same manner as when the line is found. The T and R leads being open at overflow, disconnection takes place and the line finder returns to normal as soon as the sender is found.

16. EMERGENCY RELEASE OF START CIRCUIT

If either the (STA) or (STB) relay remains operated due to the failure of the (TR) or (TR-1) relay in the trip circuit to be shunted out and released, the (KF) relay operates as soon as interrupter contacts 1, 3 and 5 close and locks under control of the (STA) or (STB) relay. If it remains locked for approximately two seconds, interrupter contacts 2 and 4 close and connect ground to either the (TR) or (TR-1) relay in the trip circuit, depending on whether the call is through the A or B sub-group, releasing the (TR) or (TR-1) relay. When ground is removed by the opening of the interrupter contacts 2 or 4, the (STA) or (STB) relay releases releasing the (KF) relay and restoring the circuit to normal.

17. START CIRCUIT ALARM

The closure of the interrupter contact 6 which occurs at the same time contacts 2 and 4 are closed while the (KF) relay is operated, operates the (KA) relay. The (KA) relay operated locks under control of the key at the trouble desk, lights a lamp at the trouble desk individual to the line finder frame and operates an alarm. The operation of the key releases the (KA) relay, extinguishing the lamp and silencing the alarm.

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18. ALL SELECTORS IN ONE SUB-GROUP BUSY

If all the selectors in sub-group A, for example, are busy, the (CA) relay operates in a circuit from ground over lead CH, 500 ohm winding of the (CA) relay to battery through the 600 ohm resistance C. The (CA) relay operated transfers the circuit over lead I from the winding of the (STA) relay to battery through the winding of the (SA) relay and the break contact of the (SB) relay. When a call is now received the (SA) relay operates in turn operating the (STB) relay. The (STB) relay operated operates the (K) relay, starts a selector in the B sub-group hunting for the calling line, and closes a locking circuit through the 1000 ohm winding and make contact of the (CA) relay. This is to prevent the release of the (CA) relay should a selector become available in the A sub-group while a call is going through the B sub-group. If all selectors in sub-group B are busy, the operation is similar except that the (CB), (SB) and (STA) relays now operate. The (STA) relay operated, starts a selector in the A sub-group hunting as explained before.

19. ALL SELECTORS IN BOTH SUB-GROUPS BUSY

If all the selectors in both sub-groups are busy, both the (CA) and (CB) relays are operated. Should a call be received in either sub-group under these conditions the corresponding (SA) or (SB) relay operates but neither the (STB) nor (STA) relay operates as the circuits to ground on the armatures of the (CA) and (CB) relays are open. When a call is received in the A or B sub-group while all selectors are busy, the message register in the start circuit operates through the make contacts of the (SA) relay to ground on the armature of the (CB) relay if the call is in sub-group A or through the make contacts of (SB) relay to ground on the armature of the (CA) relay if the call is in sub-group B. The message register thus indicates the number of calls which were originated while all the line finders were busy.

20. LINE FINDER TIME ALARM

See Open #2
If a line finder does not find the subscriber's line within 35 seconds after the receiver at the calling station is removed from the switchhook, an alarm is given in the following manner:

The (BA) relay operated connects battery to lead B, winding of the (frame) relay (B) brush and terminal 1 of the START arc of the time alarm selector, break contact of the frame relay (Δ), to the interrupter contact. When the interrupter contact closes; the (B) relay operates. The (A) relay does not operate, however, on account of its winding being short circuited by ground on the interrupter. When the interrupter contact opens, the short circuit is removed from the winding of the (A) re-

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lay, which now operates in series with the winding and make contact of the (B) relay, to ground on the armature of the (B) relay, thus holding both relays operated. The next operation of the interrupter operates the (TA) magnet, over a circuit from ground on the make contact of the interrupter, make contact of the (A) relay, terminal 1 and brush of the STEP arc of the selector, to battery through the winding of the (TA) magnet. When the interrupter contact opens, the (TA) magnet releases and steps its brushes one step on its back stroke. The selector brushes advance one step for each make and break of the interrupter contact, which is of an interval of 7 seconds, until the fifth terminal of the selector is reached when the circuit through the interrupter is opened. When the fifth terminal of the selector is reached, the BA-1 lamp in the trip circuit lights from battery on the armature of the (A) (frame) relay, terminal 5 and brush of the LAMP arc of the selector, lead A, through the make contact of the (BA) relay, BA-1 lamp, lead C, to ground through the winding of the (B) (aisle) relay in the time alarm circuit, which operates. The (B) relay operated, operates the (A) (aisle) relay. The (A) relay operated, lights the aisle pilot and main or monitoring board lamps through their respective auxiliary alarm circuits. When the source of trouble is removed and the (BA) relay, in the trip circuit has released, the circuits over leads A and B are opened, in turn releasing both the frame and aisle (A) and (B) relays, extinguishing the aisle and main or monitoring board lamps and silencing the alarm. The release of the (B) (frame) relay also closes a circuit from ground on its armature, through terminal 5 and the bridging brush of the RETURN arc of the selector to battery through the break contact and winding of the (TA) magnet, which operates and steps the selector brushes to terminal 6, in which position it awaits the next closure of lead B.

21. RESTORING TO NORMAL

Should the circuit over lead B be opened before the fifth terminal is reached by the selector, the (A) and (B) frame relays release. The (B) relay released, causes the selector to advance to the next normal position, awaiting closure of lead B, as previously described. The operation of the (NL) key steps the selector brushes to the next normal position by way of the STEP bridging brush and 5, 10, 15, or 20 terminal, as the case may be. If the selector has been at normal position 6, 11, or 16, when the (BA) relay operated, the operation would have been the same as described for position 1.

22. SIMULTANEOUS CALLS

If there are simultaneous calls in both the first and the last 20 lines of a group of 40 lines the relays of both sub-groups will operate as described above, starting two line finders in different sub-groups

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at the same time. In this case the H leads of the two lines are connected together and connected to battery through the (O) relay. One of the line finders will stop on the first line. The other line finder will either stop on the second line or travel to overflow and return as described previously.

23. MESSAGE REGISTER

On message register calls on individual message rate lines the message register (MR) operates on battery over the H lead when the call is charged.

24. ADVANCING THE DISTRICT - RELEASING THE TRIP CIRCUIT

The (SL) relay operated, (a) connects battery to the "S" lead, making the line test busy at the final frames and operating the (CO) relay in the trip circuit, (b) closes a circuit which operates the district (L) and (CH) relays. The (CO) relay operated releases the (L) relay in the trip circuit which in turn releases the (BA) relay and opens the circuit through the primary winding of the (O) relay. Another call may now be started within this same group of 20 lines if the start circuit is ready for the call, provided there are no calls waiting in other groups which have not been served. The (SL) relay operated closes a circuit which operates the (L) and (CH) relays. This circuit is traced from ground on the M commutator brush and segment through the break contact of the (F) relay make contact of the (SL) relay, cam O to battery through both windings of the (CH) relay. This same ground is then connected through cam O, cam R to battery through the 800 ohm winding of the district (L) relay. The (CH) relay operated, closes a circuit from ground on cam I, break contact of the (CS) relay, make contact of the (CH) relay to battery through the selector time alarm circuit (not shown) which performs no useful function at this time. The (L) relay operated, closes a circuit advancing the district switch to position 2. This circuit is traced from battery through the R magnet, cam B, make contact of the (L) relay, to ground through cam M. As the switch advances from position 1, the circuits through the (L) and (CH) relays are opened, releasing the relays and disconnecting the selector time alarm circuit. In position 1-1/2 to 2, the associated sender is held busy by ground through cams I and C.

26. COMPLETING FUNDAMENTAL CIRCUIT

With the switch in position 2, the tip and ring leads are closed from the calling line to the tip and ring leads of the associated sender circuit, thus permitting the dialing tone to be transmitted back over the dialing circuit from the associated sender, as an indication

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that the apparatus is ready to receive the call by the operation of the station dial. The tip side of the dialing circuit is closed from the tip of the line, through the break contact of the (F) relay, cam P, to the tip brush of the sender selector. The ring side of the dialing circuit is closed from the ring lead of the line, through the break contact of the (F) relay, cam Q to the R brush of the sender selector. In position 2, the (CI) relay operates, through its outer winding to ground on cam S, and remains operated until the switch advances from position 10. The (CI) relay operated, (a) connects ground through the inner contacts of cam S, to the test brush of the sender selector, thus making the associated sender test busy after the switch advances to position 2, (b) closes the tip side of the fundamental circuit through to the sender, and (c) operates the (CI-1) relay. The (CI-1) relay operated closes the sender control SC lead through cam V, cam U, to battery through the outer winding of the (D) relay. After the sender functions, the fundamental circuit is established for the operation of the district (L) relay and the stepping relay in the sender. This circuit is traced from ground in the sender circuit, through the FT brush, make contact of the (CI) relay, cam L, to battery through the 1200 ohm winding of the (L) relay, which operates. The (L) relay operated, locks through its 1200 ohm winding and make contact through cam M, to the same ground over the FT lead, and advances the switch to position 3 from ground on cam M. The 500 ohm winding of the (CH) relay is also connected through cam U, in parallel with the winding of the (D) relay. Should the (CH) relay operate at this time due to a high resistance ground in the sender circuit, no useful function will be performed.

26. DISTRICT BRUSH SELECTION

With the switch in position 3, the UP magnet is operated for brush selection over a circuit traced from battery through the winding of the magnet, cam C, make contact of the (L) relay, to ground through cam M. As the selector moves upward in position 3, carrying the commutator brushes over the commutator segments, the A segment and brush intermittently connect ground to the tip side of the fundamental circuit through cams K and L, holding the (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its reoperation until the proper brush has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the UP magnet, thereby stopping the upward movement of the selector and advances the switch to position 4. When two digit senders are used with this circuit, the advance of the sender replaces

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the high resistance on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. In position 4, the trip magnet (TM) is operated from ground through cam S, and the (L) relay is operated and locked to ground on the fundamental circuit previously described, advancing the switch to position 5.

27. DISTRICT GROUP SELECTION

With the switch in position 5, the UP magnet is reoperated and the trip magnet being operated, causes the previously selected set of brushes to trip when the selector starts upward. As the selector moves upward for group selection, carrying the brushes over the commutator segments, the B segment and brush intermittently connects ground to the tip side of the fundamental circuit through cam L holding the district (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its operation until the proper group has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay which in turn opens the circuit through the UP magnet and advances the switch to position 6. When three digit senders are used with this circuit, the advance of the sender replaces the high resistance ground on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. In position 5 to 6 1/4 a circuit is closed from battery through the (B) brush and 1 terminal of the line test selector, winding of the (PT) selector, brush and 1 terminal of the (S) arc cam H to ground energizing the (PT) selector magnet. When the switch advances from position 6 1/4, the energizing circuit is opened, releasing the (PT) selector which steps its brushes one terminal on its back stroke. The line test selector remains in position 2 until the sequence switch is advanced to position 9 3/4. With the switch in position 6, a circuit is closed from ground on the line finder N commutator, brush and segment, through the break contact of the (F) relay, make contact of the (SL) relay, inner contacts of cam O, cam R, to battery through the 800 ohm winding of the (L) relay, operating the relay. The (L) relay operated, advances the switch to position 7.

28. TRUNK HUNTING WITH TRUNK IDLE

Should the first trunk in the group in which the selector is hunting be idle, the (L) relay releases as the switch leaves position 6 1/4. When the switch enters position 6 1/2, ground is connected to the sleeve of the selected trunk through cam M, break contact of the (L) relay, Cam E, as a busy condition until the switch advances to position 7 3/4.

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29. TRUNK HUNTING WITH TRUNK BUSY

Should the first trunk in the group in which the selector is hunting be busy, the (L) relay is held operated in a circuit from battery through its inner winding and make contact, cam E to ground on the sleeve terminal of the busy trunk. With the switch in position 7, the UP magnet is reoperated from ground, on cam M under control of the (L) relay and the selector travels upward until an idle trunk is found. When the idle trunk is found, the locking circuit through the inner winding of the (L) relay is opened but the relay does not release immediately, due to a circuit being closed from battery through its outer winding, cam R to ground through the C commutator brush and segment. When the brushes are centered on the trunk terminals, the circuit through the C commutator segment is opened and the (L) relay releases and opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the selected trunk. The (L) relay released, also advances the switch to position 8.

30. "C" COMMUTATOR

The adjustment of the "C" commutator brush, with relation to the tripped sleeve multiple brush, is such, that it does not break contact with the C commutator, until slightly after the holding circuit through the inner winding of the (L) relay is opened, by the sleeve brush leaving the busy terminal and making contact with the sleeve terminal of the idle trunk. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the trunk terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through the outer winding of the (L) relay is opened at the "C" commutator releasing the (L) relay which in turn releases the UP magnet. The selector then drops into place, thus centering the brushes on the trunk terminal. During trunk hunting, in position 7 only, the commutator feed ground is supplied from ground on cam M under control of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit between the C commutator brush and segment on the overthrow of the selector or as it drops into place.

31. SELECTION BEYOND

As the switch advances to position 7 3/4, ground through cam E is connected to the sleeve of the selected trunk as a busy condition. With the switch in position 8, a circuit is closed from ground on the armature and make contact of the (CH) relay, through cam O, cam R to battery through the outer winding of the (L) relay, which operates

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advancing the switch to position 9. In position 9, the tip and ring sides of the outgoing fundamental circuit are closed through the tip and ring terminals of the selected trunk for selection beyond, through the FT and FR brushes of the sender selector, and cams F and G respectively. After selection beyond has been completed, ground in the sender is removed from the SC lead, releasing the (CH) relay, in turn releasing the (L) relay. The (L) relay released, advances the switch to position 10. As the switch leaves position 9 the dialing circuit is opened at cam P and as it leaves position 9 1/2 the dialing circuit is opened at cam Q and in position 9 3/4 the ring lead from the line finder is closed through cam Q to the (PT) selector switch and in position 10 the tip lead is closed from the line finder through cam P to the (PT) selector switch.

32. FIRST TEST OF CALLING LINE

As the district switch enters position 9 3/4 to 10 1/2, the (PT) magnet operates in a circuit through the 5 brush and 2 terminal, to ground on cam H. The (PT) magnet operated, steps the brush assembly to terminal 3. With the line test switch on terminals 3, 4, 5 and 6, 48 volt battery is connected to the tip side of the subscriber's line, through terminal 3 and (T) brush of the selector and cam P. The charge in the station condenser is thus neutralized so that it will not interfere with the proper functioning of the (T) relay as the line is tested, when the line test switch enters a test position. A circuit is also closed from battery through one winding of the repeating coil, winding of the (DC) relay, R-3 brush and terminal 3 of the test switch, to ground through the non-inductive winding of the (RC) relay, operating the (DC) relay. The operation of the (DC) relay closes a holding circuit for the (D) relay. With the line test switch on terminal 3, a circuit is also closed from battery through its (B) brush and 3 terminal, to ground through the inner winding of the (RT) relay which operates.

33. ROUTINE TEST

The (RT) relay operated, (a) closes a circuit from ground on the (C) brush and 3 terminal of the line test switch, make contact and 3400 ohm winding of the (RT) relay, to battery through the winding of the (T) relay which operates and (b) connects ground on its armature to the selector time alarm circuit. The function of the (RT) relay is to make a routine test of the (T) relay on each call before it is connected to the line in connection with making two party tests. If the (T) relay operates satisfactorily in series with the 3400 ohm winding of the (RT)

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relay, it does so on less current than it would receive under the worst line circuit conditions, thus assuring its operation under the worst circuit condition. If the (T) relay does not operate in series with the 3400 ohm winding of the (RT) relay, the (PT) selector remains on terminal 3, causing the selector time alarm circuit to function. When the (T) relay operates on a routine test, a circuit is closed from ground on its armature, make contact of the (RT) relay, to battery through the inner winding of the (I) relay, which operates. The (I) relay operated, closes a circuit from ground on its armature, terminal 3 and S brush of the party line test switch to battery through the winding and break contact of the (PT) magnet, operating the selector which steps the brushes to terminal 4. With the line test switch on terminal 4, the operating circuit for the (T) relay is opened, at the C brush, releasing the (T) relay. The (T) relay released, opens the circuit through the (I) relay which releases. The (I) relay released, steps the selector to terminal 5 in a circuit traced from ground on the armature and break contact of the (I) relay, terminal 4 and (S) brush of the selector, to battery through the winding of the (PT) magnet. With the line test switch on terminal 5, a circuit is closed from battery through the winding of the (PT) magnet, (S) brush and terminal 5 to ground through the make contact of the 149-A interrupter, operating the 200-S selector. When the contacts of the interrupter break, the energizing circuit of the selector magnet is opened, releasing the magnet, which steps the brushes to terminal 6. The 200-S selector continues to operate under control of the 149-A interrupter, advancing the line test switch to position 9.

34. TESTING SUB-STATION

At terminal 7 of the line test switch the subscriber's line is tested to determine which party on the line has originated the call, in order that the call may be registered correctly. If the call originates at the station whose ringer is connected to ground through a condenser, the (T) relay does not operate. If, however, the call originates at the station with the grounded ringer, the (T) relay operates in turn operating the (RC) relay. The (T) relay operates in a circuit from ground through the sub-station ringer, over the tip side of the line, through the cam P, (T) brush and terminal 7 of the line test selector, to battery through the winding of the (T) relay. The operation of the (T) relay closes a circuit from ground on its armature, break contact of the (RT) relay make contact of the (CI-1) relay to battery through the inner winding of the (RC) relay which operates. The (RC) relay operated, transfers the circuit to the message register as explained hereinafter.

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35. TALKING SELECTION

With the switch in position 10, the sender circuit functions and connects ground to the FT lead, causing the (L) relay to operate and lock through its inner winding over the tip of the fundamental circuit previously described. The (L) relay operated, advances the switch for talking selection. This circuit is traced from battery through the R magnet, cam B, make contact of the (L) relay, to ground through terminal 9 and (C) brush of the line test selector. As the switch advances, ground is intermittently connected to the tip side of the fundamental circuit through cam E, holding the (L) relay operated, but successively short-circuiting and permitting the reoperation of the stepping relay in the sender circuit. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the R magnet, stopping the switch in position 11, 12 and 13, depending upon the class of call. With the line test switch on terminal 9, the (T) relay releases, and 48 volts battery is disconnected from the tip side of the line. With the line test switch on terminal 9 and the district sequence switch in position 10, a circuit is closed energizing the 200-S selector. This circuit is from ground cam H, terminal 9 and (S) brush of the switch, winding of the (PT) magnet, to battery through terminal 9 and (B) brush of the selector. As the district switch advances from position 10/1/2, the operating circuit of the (PT) magnet is opened at cam H, releasing the magnet which steps its brushes to terminal 10. With the test switch on terminal 9, the holding circuit of the (DC) relay is transferred from the non-inductive winding of the (RC) relay and closed metallic over the sub-station loop. This circuit is traced from battery through one winding of the repeating coil, winding of the (DC) relay, (R) brush and terminal 9 of the line test switch, cam Q, break contact of the (F) relay, terminal and brush of the line finder, through the station loop, back through the terminal and brush of the selector break contact of the (F) relay, lower contact of cam P, (T) brush and terminal 9 of the test switch to ground through the outer winding of the repeating coil.

36. DISCHARGING THE SENDER

With the (DC) relay operated, a locking circuit is closed for the (D) relay after the switch advances from position 9. This circuit is traced from battery through the inner winding of the (D) relay, make contact of the (DC) relay, make contact of the (D) relay to ground through cam I. The (D) relay (178-AK) is made slow in releasing so that the connection will not be lost if the switchhook at the called station is momentarily depressed. As the switch leaves position 10, the holding

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circuit of the (CI) relay is transferred from ground on cam S to ground on cam E, under the control of the (L) relay. This circuit is traced from battery through the outer winding of the (CI) relay, inner contacts of cam U, make contact of the (CI) relay, cam V, make contact of the (L) relay to ground through cam E. The release of the (L) relay opens the holding circuit through the (CI) relay, disconnecting the sender from the district circuit.

37. CALLED PARTY ANSWERS

When the receiver at the called station is removed from the switchhook, with the switch in position 11 or 12, reversed battery and ground from the incoming circuit operates the (CS) relay. The (CS) relay operated, closes a circuit from ground on cam I, through cam N, to battery through the winding of the (I) relay, #3 contact of the 160-H interrupter. When the interrupter contact closes, the (I) relay operates and locks on the same ground through its make contact. When the #4 contact of the interrupter closes, the operation of the (I) relay closes a circuit from ground on the interrupter contact to battery through both windings of the (CH) relay, operating the relay. The (CH) relay operated, locks through its windings cam O, to ground on its make contact and armature and closes a circuit from battery on its make contact to hold the (SL) relay operated. The 160-H interrupter is so connected in the circuit that the operation of the (CH) relay is delayed for at least two seconds after (CS) relay operates. This delay is to prevent the false operation of the (CH) relay should the (CS) relay operate momentarily before the called party answers, due to any line disturbances.

38. OPERATOR ANSWERS

The switch advances to position 13, as described above and when the operator inserts the plug of an answering cord in the answering jack of the trunk, the (CS) relay operates on reverse battery and ground, over the trunk. The (CS) relay operated, closes a circuit from ground on cam I, through cam R, to battery through the outer winding of the (L) relay, which operates and advances the switch to position 14. With the switch in position 14, the repeating coil and battery are disconnected and the T and R leads are connected directly to the T and R brushes of the selector through cams P and Q, respectively. As the switch enters position 13-1/2, the (L) relay locks in a circuit from ground over lead S of the selected trunk, and in position 14, the locking circuit through the inner winding of the (D) relay is transferred from the contacts of the (DC) relay to the contacts of cam J. In position 14, a checking tone circuit is closed over the sleeve of the operator's trunk, cam E, make contact of the (L) relay, cam V, 2 mf condenser, cam X, the S brush and terminal at the line finder bank, to ground through the winding of the (CO) relay for number checking.

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39. DISCONNECTION - REGULAR CALL

When the receiver at the calling station is replaced on the switch-hook, the (DC) relay releases, in turn releasing the (D) relay. The (D) relay released, closes a circuit through the R magnet, advancing the switch to position 16. Test switch goes into position 11 as sequence switch passes position 13 1/2. As the switch enters position 14 3/4 ground is connected through cam H, terminal 11 and S brush of the line test switch to battery through the winding of the (PT) magnet and terminal 11 and (B) brush of the test switch, energizing the magnet. When the switch leaves position 15 1/4, the energizing circuit for the (PT) magnet is opened at the cam H, releasing the magnet and advancing the line test switch in terminal 12. The 160-H interrupter steps the switch to terminal 16.

40. SECOND TEST OF CALLING LINE

As the line test switch passes over terminals 12 and 13 with the district switch in position 16, battery is connected through the (T) brush and cam P to the tip side of the line to discharge the sub-station condenser. On terminals 14, 15, and 16 of the line test switch, a second test is made on the line. During this test, the tip and ring of the line are short-circuited through the make contact of the (CH) relay in order to test for a foreign ground on either side of the line. With the district switch in position 16, the (I) relay operates in a circuit from battery through its inner winding, to ground on terminal 12 and (C) brush of the line test switch, and remains operated until the line test switch advances from position 15. If the (T) relay operates in positions 14 to 16 of the test switch, the (I) relay is held operated and the line test switch steps to terminal 16. The holding circuit is traced from ground on the armature of the (T) relay, back contact of the (RT) relay, contacts of (CI-1) relay to battery through the inner winding of the (I) relay. With the (I) relay operated, the test switch is held on this terminal and a circuit is closed, operating the selector time alarm circuit. When the alarm is investigated, the sequence switch must be advanced to position 17, manually, to prevent a false charge to the calling station. If, however, the line is free from ground when the second test is made, the (T) relay does not operate and the (I) relay releases and closes a circuit from ground through its break contact, terminal 16 and (S) brush of the test switch, to battery through the winding and break contact of the (PT) magnet, stepping the brushes to terminal 17. The selector then steps to position 20 under control of the 149-J interrupter in order to allow sufficient time for the operation of the message register in the associated line circuit. As the line test switch passes over terminal 19, a message register circuit is closed from battery through the make contact and armature of the (CH) relay, operating the proper message register in the associated line switch circuit.

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41. MESSAGE REGISTERING

As explained under first test of calling line, the (RC) relay operates and locks on the first line test when the call originates at the station with the grounded ringer, but does not operate on line tests when the call originates at the station whose ringer is connected in series with a condenser. The operation or non-operation of the (RC) relay determines which station register shall register the call. If a call originates at the station whose ringer is connected to ground in series with a condenser, the (MR-1) message register in the line circuit operates. The registering circuit is traced from battery on the make contact of the (CH) relay through cam T break contact of the (I) relay, break contact of the (RC) relay, through the 18-AN resistances in multiple over lead H, break contact of the (L) relay, make contact of the (CO) relay, through winding of the (MR-1) message register to ground.

42. On calls originating at the station whose ringer is permanently connected to ground, the (RC) relay operates and locks and closes a circuit, short-circuiting the (E) relay which releases. This circuit is traced from ground on (C) brush, terminals 18 and 19 of the line switch, make contact of the (RC) relay to the winding of the (E) relay, short-circuiting the inductive winding of the (E) relay. The (E) relay released, (a) opens the circuit through the (SL) relay which releases, (b) opens the operating circuit for the (MB) relay, but the (MB) relay does not release on account of a circuit being closed to ground on cam I. The release of the (SL) relay opens the circuit, releasing the (CO) relay. When the (CO) relay releases, the (MR-2) message register is connected to lead H and the registering circuit for the second party station is traced from battery on the make contact of the (CH) relay, break contact of the (I) relay, make contact of the (RC) relay, contact of the (G) relay, through the 18-AN resistances in multiple, brush and commutator of the (LF) selector, over lead H, break contact of the (L) and (CO) relays, to ground through the winding of the (MR-2) message register.

43. As the operation of register (MR-2) is dependent on the release of the (SL) relay, it will be noted that the sleeve of the line at the final frame is left unguarded by the release of the (SL) relay. In the event that the line is again seized by a final selector immediately upon the release of the (SL) relay, the (G) relay operates and opens the register circuit, thus preventing the wrong station being charged with the call. The (G) relay operates in a circuit from ground through cams E, L, and H, through the winding of the (G) relay, over the S lead to battery on the S lead of the final selector which seized this line.

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44. RESTORING LINE FINDER TO NORMAL

As the line test switch steps to terminal 20, a circuit is closed from ground on the (C) brush and terminal 20 of the line test switch, break contact of the (L) relay through cam B to battery through the R magnet, advancing the district switch to position 17. The A cam advances the switch to position 18. As the switch enters position 17, a circuit is closed operating the (DS) relay in the line finder circuit. This circuit is traced from ground on the M commutator brush and segment, through the 350 ohms winding of the (DS) relay, cam N, break contact of the (DS) relay. The (DS) relay operated, (a) locks through its make contact and 350 ohm winding to the same battery, (b) closes a circuit through the outer winding of the (F) relay, thus insuring the holding of this relay until both the line finder selector and the district selector have returned to normal, (c) operates the line finder DOWN magnet from ground on its armature, which restores the line finder selector to normal. When the line finder selector returns to normal, ground is disconnected from the M commutator segment, releasing the (E), (DS) and (MB) relays.

45. RESTORING DISTRICT TO NORMAL

With the district switch in position 18, a circuit is closed from ground on cam I, break contact of the (D) relay, cam D, terminal 20 and (S) brush of the test switch, to battery through the winding of the (PT) magnet which operates and advances the switch to terminal 21. With the line test switch on terminal 21, the circuit is closed from ground on the (C) brush and terminal 21 of the test switch to battery through the DOWN magnet, restoring the selector to normal. When the district selector reaches the bottom of the frame, a circuit is closed from ground through the Y commutator brush and segment, (D) brush and terminal 21, (S) brush and terminal to battery through the (PT) magnet, stepping the brushes to terminal 22. With the test switch on terminal 22 a circuit is closed from ground on the terminal 22 and (S) brush to battery through the (PT) magnet, stepping the switch to terminal 1. With the line test switch on terminal 1, ground through the Y commutator brush and segment, (D) brush and terminal 1 of the line test switch, cam B to battery through the R magnet, advances the district switch to position 1. As the switch leaves position 18, the circuit through the DOWN magnet is opened, and after position 18 1/4, the circuit through the outer winding of the (F) relay is opened, releasing the relay.

46. DELAYED DISCONNECT

Should the calling subscriber fail to replace the receiver on the switchhook after the called subscriber has disconnected, the release of

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the (CS) relay, due to the incoming trunk functioning, operates the selector time alarm circuit from ground through cam I over the circuit previously described, thereby notifying the switchman of the existing condition.

47. DISCONNECTION - TALKING TO OPERATOR

With the plug of the answering cord in the trunk jack at the incoming end, ground is connected to the sleeve terminal of the trunk to hold the district (L) relay operated. If the plug of the cord is removed from the trunk jack before the receiver at the calling station is replaced on the switchhook, the line relay in the trunk circuit operates, thereby holding the ground on the sleeve terminal of the trunk. When the receiver at the calling station is replaced on the switchhook and the plug of the answering cord is removed from the trunk jack at the incoming end, the (DC) relay releases, and ground is disconnected from the sleeve of the trunk, releasing the (L) relay, thus advancing the switch to position 15. As the switch advances from position 14 1/4, the locking circuit through the inner winding of the (D) relay is opened at cam J, releasing the relay. The (D) relay released, releases the (SL) relay and then advances the switch to position 16 in a circuit traced from battery through the R magnet, cam D, break contact of the (D) relay, to ground through cam I. With the test switch in position 20, a circuit is closed on the (C) brush and terminal 20, break contact of the (L) relay, cam B to battery through the R magnet, advancing the switch to position 17, the A cam advancing to position 18. In position 16, the (CH) relay being normal, battery is not connected over lead H to operate the message register in the line circuit, as the call is not chargeable. From this point on, the line finder and district selectors are restored to normal as described in paragraphs 44 and 45.

48. DISCONNECTION ON ABANDONED CALLS

48.1 Disconnection Before Line Finder Selector Finds Line

Should the calling subscriber replace the receiver on the switchhook before a hunting selector finds the line, the (L) relay in the line circuit releases, removing battery from the H terminal at the multiple bank. The selector therefore travels to the top of the bank and the H brush of the selector makes contact with the terminal of the H comb at the top of the multiple bank. The (H) relay operates from ground on the break contact and armature of the (DS) relay, winding of the (H) relay cam W, H brush of the selector to battery. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and opens the circuit through the UP magnet, stopping the selector. The N commutator segment is opened with the selector brush resting on the

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-sele H comb to prevent the district switch from advancing from normal when the (F) relay is released by the release of the (LF) relay. When the (F) relay releases, the (DS) relay operates from ground on the X commutator brush and segment, through its 1,000 ohm winding. The (DS) relay operated, operates the DOWN magnet restoring the selector to normal.

48.2 Positions 2 to 6

If the receiver is replaced on the switchhook at the calling station while the district switch is in positions 2 to 6, the dialing circuit is opened at the calling station, causing the sender circuit to function and connect a direct ground to the SC lead operating the (CH) relay and causing the (D) relay to release on account of the increased current flow through the outer winding of the relay. The (D) relay is connected differentially, but does not release when its inner winding is connected directly to ground and its outer winding connected to ground in series with a resistance. The (D) relay released, advances the switch to position 6 in a circuit traced from ground through cam I, break contact of the (D) relay, cam D to battery through the R magnet.

48.3 In position 6 the DOWN magnet operates, restoring the district selector to normal. When the selector reaches the bottom of the bank, a circuit is closed from ground through the Y commutator brush and segment, (D) brush and terminal 1 of the test switch, cam B to battery through the R magnet, advancing the switch to position 7. In position 7, a circuit is closed from battery, break contact of the (DS) relay, break contact of the (D) relay, cam N, through the outer winding of the (DS) relay, to ground on the M commutator, operating the (DS) relay, which operates the line finder DOWN magnet returning the line finder to normal. When the district switch advances from position 6 1/4, the (L) relay releases and closes a circuit advancing the switch to position 8.

48.4 As the district switch enters position 5, the (PT) selector is operated from battery over the (B) brush and terminal, winding of the (PT) magnet, (S) brush and terminal 1 of the line test switch to ground on cam H. When the district switch advances from position 6 1/4, the (PT) magnet releases stepping the test switch to position 2. Ground on the Y commutator through the D and S brushes steps the test switch to position 4. The test selector steps to terminal 5 in a circuit from

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ground on the break contact of the (I) relay and steps to terminal 8 under control of the 149-A interrupter. Ground on terminal #8 causes the test selector to step to terminal #9. Ground on the Y commutator through terminals 9 and 10, advances the district to position 14. As the district switch passes through position $9 \frac{3}{4}$ to $10 \frac{1}{2}$, the (PT) magnet operates in a circuit from battery through the (B) brush and terminal 9, winding of the (PT) magnet, (S) brush and terminal 9 to ground on cam H. With the test switch in position 9, a circuit is closed from ground on the Y commutator through the (D) brush and terminal 9, advancing the district switch to position 11. As the district switch advances from position $10 \frac{1}{2}$, the (PT) magnet releases, stepping the line test switch to terminal 10. When the district switch advances to position 10, a circuit is closed from ground on cam I, break contact of the (D) relay, cam D to battery through the R magnet, advancing the switch to position 16. The district switch passes through position 13, the (PT) magnet operates, and when the district switch advances from $13 \frac{1}{2}$, the (PT) magnet releases, stepping the line switch to terminal 11. In position $14 \frac{3}{4}$ the (PT) magnet again operates and releases when the district switch advances from position $15 \frac{1}{4}$. The release of the (PT) magnet advances the test switch to terminal 12. Ground through the 149-A interrupter is connected through the (PT) magnet, advancing the test switch to terminal 16. On terminal 16, ground on the break contact of the (I) relay advances the test switch to terminal 17. The switch advances to terminal 20, under control of the 149-A interrupter, and closes a circuit from ground through the (C) brush and terminal 20, advancing the district switch to position 17, the A cam advancing it to position 18. Ground on cam I, break contact of the (D) relay, cam D, (S) brush and terminal 20 of the test selector advances the switch to terminal 21. The Y segment advances the switch to terminal 22. On terminal 22 ground through the (S) brush steps the test switch to terminal 1, where a circuit is closed from ground on the Y commutator, (D) brush and terminal 1, advancing the district switch to position 1.

48.5 When the line finder selector returns to normal, ground is disconnected from the M commutator, thus releasing the (E), (DS) and (MB) relays. The (DS) relay released, releases the (F) relay, restoring the circuit to normal.

48.6 Position 7 to 10

If the receiver at the calling station is replaced on the switchhook while the district switch is in position 7 to 10, the

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switch advances until selection beyond is completed, when ground is disconnected from the SC lead in position 10. After subscriber's line is tested and line test selector steps to position 9, the (DC) relay releases, releasing the (D) relay which closes a circuit from ground on cam I, break contact of the (D) relay, cam D, to battery through the R magnet, advancing the switch to position 16. As the switch advances to position 16, the line test switch steps to terminal 2D, and in position 16, the (L) relay releases, advancing the switch to position 17, the A cam advancing it to position 18.

TELL TALE - LINE FINDER SELECTOR

49. BRUSHES NOT TRIPPED

Should the line finder selector travel to tell tale due to the "N" and "C" segments being opened, the (LF) relay releases. The release of the (LF) relay releases the "UP" magnet and also releases the (F) relay provided a sender has been found. The release of the (F) relay operates the down drive magnet and reoperates the (F) relay returning the line to normal.

50. WITH BRUSHES TRIPPED

Should the selector travel to the tell tale position while hunting with the multiple brush tripped, a circuit is closed from battery in the trip circuit, terminal of the H comb at the top of the multiple bank (shown on TRIP circuit), H multiple brush of the line finder selector, contacts of cam W, winding of the (H) relay, to ground on the armature of the (DS) relay, operating the (H) relay. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay released, opens the circuit through the tell tale alarm and connects ground through the X commutator brush and segment to battery through the 1000 ohm winding of the (DS) relay, which operates, in turn operating the DOWN magnet, restoring the selector to normal.

51. TELL TALE DISTRICT SELECTOR

Should the selector travel to the tell tale position during brush selection, ground on the X commutator brush and segment is connected through cam B, to battery through the R magnet, advancing the switch to position 8. Under this condition the resistance of the circuit over the SC lead is not sufficient to operate the (CH) relay, and the district remains in position 8 until it is restored to normal manually. If the district goes to tell-tale during group selection, ground on the

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X commutator advances it to position 8. In position 8, ground on the SC lead holds the (CH) relay operated, while in turn operates the (L) relay. The (L) relay operated, advances the switch to position 9. The (CH) and (L) relays remain operated and the district remains in position 9 until it is restored to normal manually.

52. OVERFLOW

If all the trunks in the group are busy, the district selector, while trunk hunting in position 7, travels to the top of the group and rests on the overflow terminals. As the sleeve terminal at overflow is open, the (L) relay releases, in turn advancing the switch to position 8. In position 8, the (L) relay reoperates from ground on the armature of the (CH) relay, advancing the switch to position 9. In position 9, a circuit is closed from ground on the Z commutator brush and segment, through cam K to the R winding advancing the switch to position 10. In position 10, (L) relay operates, through the 1200 ohm winding. The (L) relay operated, locks through its 1200 ohm winding and make contact to the same ground, through cam L, advancing the switch to position 14 from ground on cam M. As the switch advances from position 13, the (L) relay releases, and in position 14 advances the switch to position 15. The release of the (L) relay also releases the (CI) and (CI-1) relays, disconnecting the sender from the district circuit. With the switch in position 15, a circuit is closed from the "Miscellaneous Tone Circuit" over lead C, 2 mf condenser, cam G, winding of the repeating coil, 2 mf condenser, cams V and J, make contact of the (D) relay, to ground on cam I. A tone is therefore induced in the other winding of the repeating coil, thus causing the "All Trunks Busy" tone to be sent back to the calling subscriber. When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, opening the locking circuit through the (D) relay, which releases. From this point on, the switch is advanced to position 1 as described in paragraph 47.

53. "O" COMMUTATOR

The function of the "O" commutator segment is to maintain an idle condition on the multiple overflow terminals, so that more than one selector may stop on overflow at one time; otherwise, the first selector reaching overflow would make the sleeve multiple terminals busy, thus causing succeeding selectors to continue upward into the next group of trunks. The "O" commutator segment is open at overflow, but the S bar is continuous. Both the "O" and "S" commutator brushes are permanently strapped together and wired to the multiple sleeve brush.

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When the selector is at overflow, the "O" commutator brush is resting on an open (dead) segment, and as the busy ground is fed through the "O" commutator bar only, this arrangement maintains a non-busy condition of the sleeve terminals. When necessary to combine two or more groups of trunks, the multiple sleeve overflow terminals between the combined groups are made permanently busy by being connected to ground. As the "S" commutator bar is closed at overflow, the (L) relay is held operated at this time, and the selector therefore hunts past the "made busy" terminals into the next group.

54. TESTING LINE FINDER SELECTOR

54.1 The testing equipment which is shown associated with the start circuit provides for the testing of any particular line finder selector at any time. The test line used with the test box circuit for making the test is the first or bottom line of the bottom back in both the A and B sub-groups, the first line terminals in both sub-groups being connected together. When the #184 plug is inserted in the test jack of the line finder under test, the ST and ST-1 leads are connected together, and the circuit which applied the battery to the ST lead through the (LF) relay in the line finder circuit is transferred to lead Z, or if the automatic test circuit is used, the winding of the (LF) relay in the line finder circuit is connected through the test circuit to the start circuit over lead Z. When the plug of the test box cord is inserted in the test jack or the line finder is being tested by the automatic test circuit, the (A) relay operates from ground on the test jack or lead to automatic test circuit to battery on the contact of the (AL) relay, provided the (AL) relay is normal, indicating that there are no calls waiting to be served; and also in the case of the automatic test circuit, provided the line finder is idle. The (A) relay operating locks to battery on its contact, opens the circuit over the TR lead, thereby preventing any other calls from starting, opens the battery supply lead to the AL relay thereby preventing this relay from operating on calls waiting to be served, and connects ground to the winding of the (B) relay which operates if both (STA) and (STB) relays are normal, indicating that the start circuit is ready to handle the test call. The (B) relay operating locks under control of the (A) relay, closes the test line through, thereby operating the (L) relay in the test line, opens the series path for locking up (TR) relays in all trip circuits beyond the first, in series with the (STA) relay, thereby preventing a call from being started in a succeeding trip circuit after the start circuit is

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free and before the test circuit has had time to start the line finder under test, operates the (C) and (C-1) relays and connects battery to the winding of the (D) relay.

54.2 If the automatic test circuit has found the line finder busy the circuit through the (A) relay is left open, the (A) relay does not operate, and the test call is blocked until the line finder becomes idle. The (C) relay operated (a) opens the circuit through the (SA) relay preventing this relay from operating and starting a line finder in the B group in case all the line finders in the A group become busy while the test call is going through, (b) opens the normal ST lead, (c) connects lead Z through to the (STA) relay in the start circuit and (d) opens the circuit through the (STB) relay. The (C-1) relay operated (a) closes the circuit over the TR lead from battery on the normally closed contacts of the (STA) and (STB) relays, (b) connects the K lead of sub-group A with the K lead of sub-group B thereby connecting the K commutator segments of all the selectors of both sub-groups together and (c) connects the Y lead of sub-group A with the Y lead of sub-group B so that the (GA) relay will be operated by a selector in either sub-group. When the (L) relay in the test line operates, the trip circuit functions and connects ground through the (TR) relay in the trip circuit over lead TR, make contact of (C-1) relay, break contacts of (STA) and (STB) relays to battery, operating the (TR) relay in the trip circuit. The above (TR) relay locks over lead I, break contacts of (CA) and (SB) relays to battery through the winding of the (STA) relay in parallel with the 1000 ohm resistance, operating the (STA) relay. The (STA) relay operated, short-circuits the 500 ohm winding of the (CA) relay, connects ground to lead K, operates the (D) relay, and closes a circuit from ground through the break contacts of the (GA) relay, make contacts of the (C) relay over lead Z to battery through the (LF) relay in the line finder circuit, causing the line finder to start hunting for the calling line. The (D) relay operated locks to ground on the armature of the (A) relay. When the (STA) relay releases after the line finder has passed the tripping zone, the (E) relay operates from ground on the left inner armature of the (STA) relay, make contact of the (D) relay to battery through the break contact and winding of the (E) relay. The (E) relay operated locks to ground on the armature of the (A) relay, releases the (C) and (C-1) relays, closes the series path for locking up the (TR) relays in the trip circuits beyond the first, which was opened by the (B) relay, closes the circuit from battery on the contacts of the (STA) and (STB) relays which was opened by the

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and operation of the (A) relay and later closed by the operation of the (C-1) relay, through to the TR lead, and closes battery to the (AL) relay which was removed by the operation of the (A) relay. This leaves the start circuit prepared to handle regular calls. When the plug of the test box cord is removed from the jack, or the automatic test circuit has been restored to normal, the (A) relay is released, releasing the (B), (D) and (E) relays and restoring the testing equipment to normal.

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September 2, 1926. S. C. E.
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